# 27013 - Geometry of Curves and Surfaces

**Información del Plan Docente**

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| **Academic Year** | 2018/19 |
| **Subject** | 27013 - Geometry of Curves and Surfaces |
| **Faculty / School** | 100 - Facultad de Ciencias |
| **Degree** | 453 - Degree in Mathematics |
| **ECTS** | 10.5 |
| **Year** | 3 |
| **Semester** | Annual |
| **Subject Type** | Compulsory |
| **Module** | --- |

## 1.General information

## 1.1.Aims of the course

## 1.2.Context and importance of this course in the degree

## 1.3.Recommendations to take this course

## 2.Learning goals

## 2.1.Competences

## 2.2.Learning goals

## 2.3.Importance of learning goals

## 3.Assessment (1st and 2nd call)

## 3.1.Assessment tasks (description of tasks, marking system and assessment criteria)

## 4.Methodology, learning tasks, syllabus and resources

### 4.1.Methodological overview

The methodology followed in this course is oriented towards the achievement of the learning objectives. A wide range of teaching and learning tasks are implemented, such as lectures, problem-solving sessions, laboratory sessions, tutorials and autonomous work and study.

### 4.2.Learning tasks

This course is organized as follows:

Face to face work(105 hours).

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- **Lectures**.
- **Problem-solving sessions**. Blackboard problem-solving activities.
  - o Teamwork involving written and oral presentations. LaTeX prepared texts and use of English is encouraged.
- **Laboratory sessions**. Computer problem-solving activities using free software. (Five two-hour sessions)
- **Tutorials**. Teacher will attend student during office hours.
- **Autonomous work and study** (157,5 hours).

## 4.3.Syllabus

The goal of the course "Geometry of curves and surfaces" is the study of the differential geometry of curves and surfaces in the euclidean plane and space.

This course will address the following topics:

- **Topic 1.** Regular plane curves. Frénet's frame, tangent and normal vector fields along a curve, curvature, arc length. Fundamental Theorem for plane curves.
- **Topic 2.** Biregular spatial curves, Frénet frame (tangent, normal and binormal fields), arc length, torsion, curvature, evolute. Fundamental Theorem for spatial curves. Local canonical form.
- **Topic 3.** Regular surfaces. Local theory: 2-function graphs, charts and regular values of 3-functions. Examples. Parametrized surfaces. Curves in surfaces and Tangent plane. Charts, coordinate vector fields, differentiable functions and maps. First fundamental form: lengths, angles and areas.
- **Topic 4.** Geometry of Surfaces. Geodesic and normal curvature. Second fundamental form and Gauss map. Types of points, principal, normal and Gauss curvature. Principal directions, asymptotic curves, umbilic points. Vector and direction fields.Ruled and minimal surfaces.
- **Topic 5.** Intrinsic Geometry. Covariant derivative and Gauss Theorema Egregium. Isometries, conformal maps and isothermal coordinates. Geodesics and exponential map: distance and convexity. Gauss-Bonnet Theorems.

Some other topics, as those related with global geometry of curves and surfaces will be developed by the students in groups: Isoperimetric inequality, Four-vertex Theorem, Regular neighbourhoods of compact curves and surfaces, Differentiable Jordan Curve Theorem, Fenchel's Theorem, hyperbolic geometry, minimal and ruled surfaces, etc.

## 4.4.Course planning and calendar

As a general rule, there are three weekly lecture-problem periods in the first term and four in the second one.

Further information concerning the timetable, classroom, office hours, assessment dates and other details regarding this course will be provided on the first day of class or please refer to the Faculty of Sciences website (http://ciencias.unizar.es/) and Moodle.

## 4.5.Bibliography and recommended resources
- do Carmo, Manfredo P., *Differential geometry of curves and surfaces*, Prentice-Hall, Inc., Englewood Cliffs, N.J}, 1976, viii+503.
- Cordero, Luis A. *Geometría diferencial de curvas y superficies con Mathematica* / Luis A. Cordero, Marisa Fernández, Alfred Gray . Buenos Aires. Addison-Wesley Iberoamericana, cop. 1995
- Costa, Antonio F. *Notas de geometría diferencial de curvas y superficies* / Antonio F. Costa, Manuel Gamboa, Ana M. Porto Madrid : Sanz y Torres, D.L. 1997